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Description of two new phanerobranch nembrothid species (Nudibranchia: Polyceridae: Doridacea)

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Two new species of dorid nudibranchs of the genus *Tambja* are described from the Indo-Pacific and the temperate waters of the western Atlantic. *Tambja haidari* sp. nov. is only known from the type locality in Senegal. This species has dark blue ground colour with yellow bands and sky-blue spots, which become real tubercles along the tail. The internal features are typical of species of the genus, with rachidian teeth that lack denticles and with a prostate slightly differentiated from the rest of the vas deferens. *Tambja blacki* sp. nov., from Papua New Guinea and eastern Australia, has yellow-green or green colour with black blotches. There are two large blotches on the head continuing from the inner side of the base of the rhinophores towards the rear. The notal margin is elevated and joins behind the gill in a well-developed hump. The reproductive system of this species is very characteristic because it has some features more typical of species of *Nembrotha* than of *Tambja* (i.e. vaginal gland absent, prostate spread over the bursa copulatrix and wide and elongate vagina). These descriptions bring the number of species of *Tambja* found around the world to 31.

INTRODUCTION

Since the genus *Tambja* was erected, the number of species described has continuously increased (see Pola et al., in press). Examination of recently collected specimens has permitted the description of four new species from the Indo-Pacific (Pola et al., 2005a) and a new species from Brazil (Pola et al., 2005b). A systematic review of the genus and a preliminary molecular phylogeny is in progress. Additional material from two different regions of the world (Senegal and eastern Australia) was examined for the present study. The high number of newly described species highlights the need for extensive sampling, since photographs of many other undescribed species appear in different books and web pages (e.g. Coleman, 2001; www.seaslugforum.net).

Species of *Tambja* are characterized by having rachidian teeth with a notched or smooth upper margin, a bifid lateral tooth or with a simple cusp and from three to seven marginal plates. They have a strong buccal collar and lack a labial armature. The prostate gland is small and confined to a glandular section of the vas deferens (Burn, 1967).

The descriptions of two new species are presented in this paper. It is notable that one of the new species shares with three other species of *Tambja* (*T. limaciformis* Eliot, 1908, *T. abdere* Farmer, 1978 and *T. amakusana* Baba, 1987) a reproductive system with some features more similar to those of the genus *Nembrotha*.

SYSTEMATICS

NUDIBRANCHIA Cuvier, 1817
Family POLYCERIDAE Alder & Hancock, 1845
Genus *Tambja* Burn, 1962

Type species: *Nembrotha vercornis* Basedow & Hedley, 1905:158, pl. II, figures 1–3.

Tambja haidari sp. nov.
(Figures 1A,B, 2A,B,D–F & 3A)

Type material

Holotype: adult specimen, 37 mm alive (28 mm preserved) ('Gouye teni m'bot', Dakar, Senegal; water depth: 23 m) [Museo Nacional de Ciencias Naturales (Madrid), MNCN 15.05/46710]. Collected by Marina Poddubetskaia, June 2005.

Paratypes: two adult specimens both dissected, 52 and 42 mm alive (33 and 30 mm preserved) (same locality, date and collector as holotype) [MNCN 15.05/46710].

Etymology

This species is dedicated to Mr Haidar El Ali, a fervent ecologist who is making a significant contribution to the Senegalese environment.

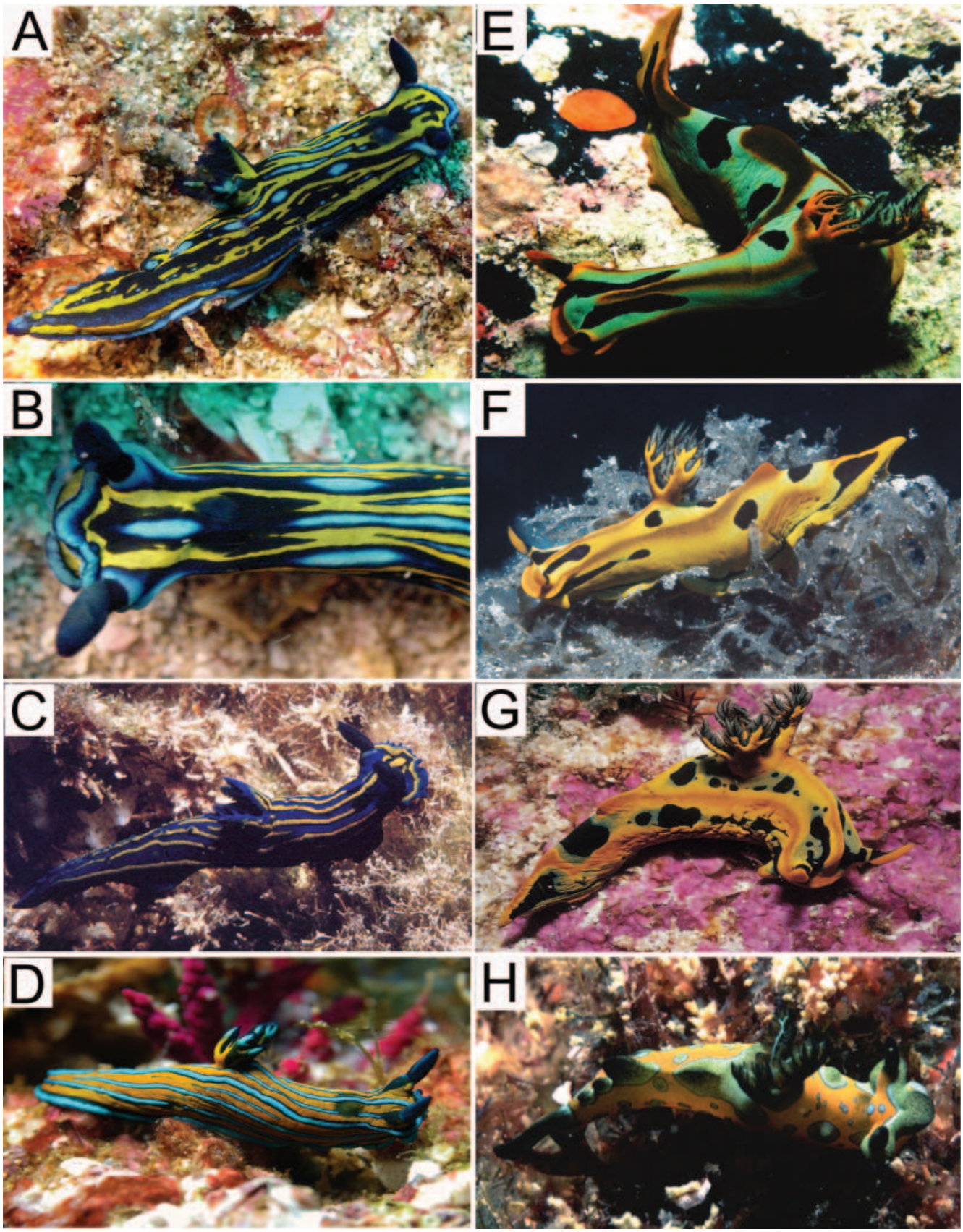

Figure 1. (A–H) Photographs of the living animals. (A&B) *Tambja haidari* sp. nov., Dakar, Senegal. Holotype. Photograph by Marina Poddubetskaia; (C) *Tambja ceutae*, Azores, Potugal. Photograph by Peter Wirtz; (D) *Tambja eliora*, Baja California, Mexico. Photograph by Alicia Hermosillo; and (E–G): (E) *Tambja blacki* sp. nov., Heron Island, Great Barrier Reef, Australia. Holotype. Photograph by Nerida Wilson; (F) *Tambja blacki* sp. nov., Heron Island, Great Barrier Reef, Australia. Photograph by Neville Coleman; (G) *Tambja blacki* sp. nov., Papua New Guinea. Photograph by Neville Coleman. Specimen not collected; (H) *Tambja stegosauriformis*, Rio de Janeiro, Brazil. Photograph by Carlo Magenta.

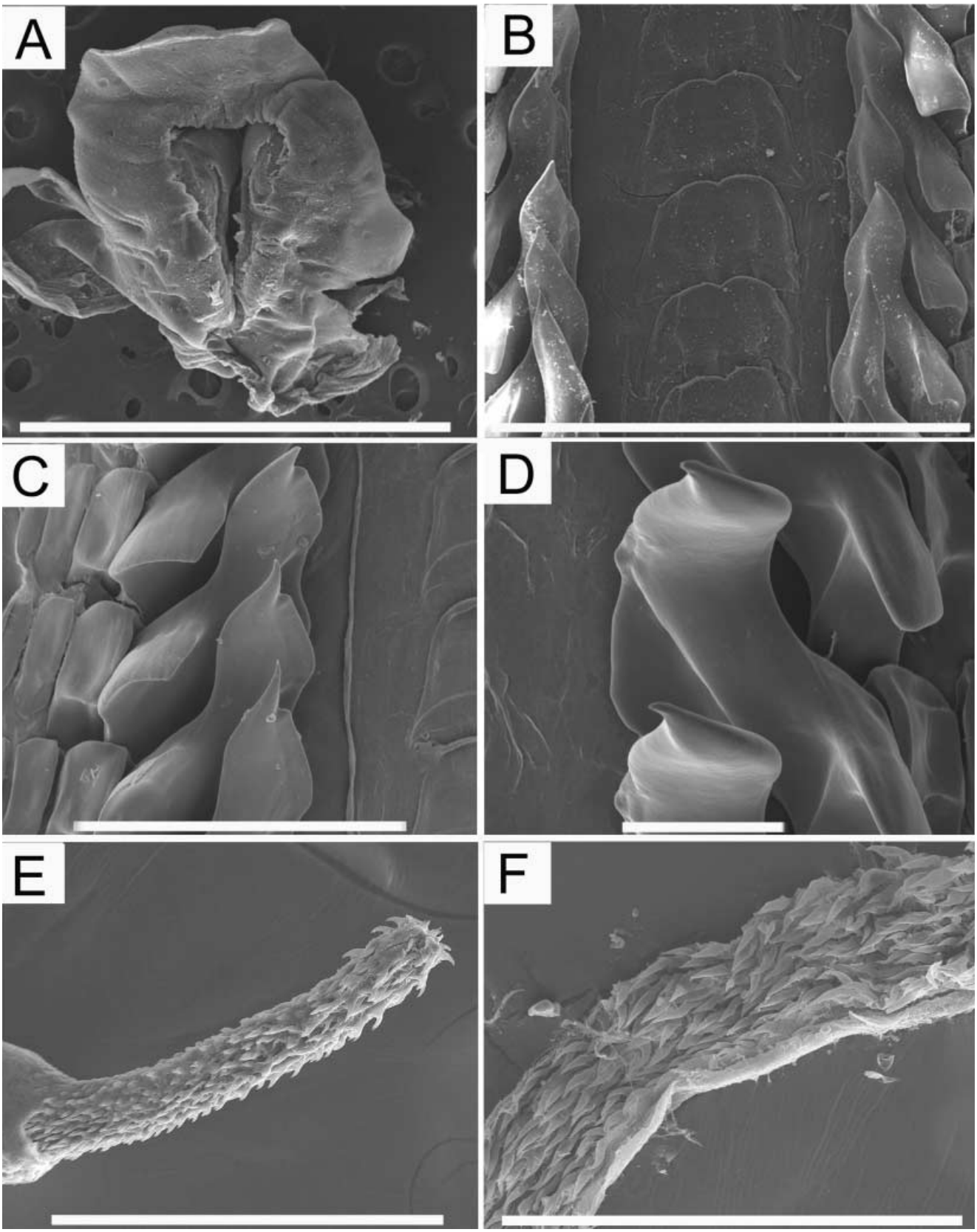

Figure 2. (A–F) Scanning electron micrographs. (A&B) *Tambja haidari* sp. nov. (paratypes): (A) detail of labial cuticle; (B) detail of the rachidian teeth and the innermost lateral teeth; (C) detail of the innermost lateral tooth, *Tambja ceutae* (MMF 29890); (D) detail of the innermost lateral tooth, *Tambja eliora* (MNCN 15.05/46665); (E&F) *Tambja haidari* sp. nov. (paratypes): (E) penis; and (F) detail of the penial spines. Scale bars: A, 2 mm; B, 1 mm; C, 500 μm; D, 200 μm; E,F, 300 μm.

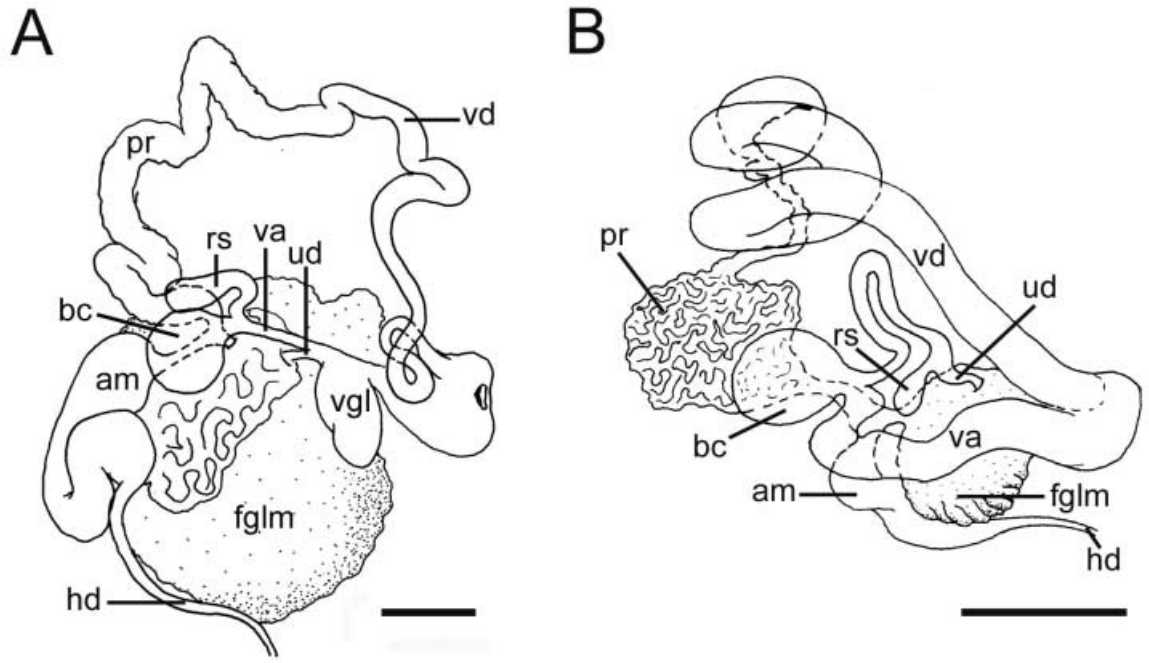

Figure 3. (A) Reproductive system of *Tambja haidari* sp. nov; (B) reproductive system of *Tambja blacki* sp. nov. am, ampulla; bc, bursa copulatrix; fglm, female gland mass; hd, hermaphrodite duct; pr, prostate; rs, receptaculum seminis; ud, uterine duct; va, vagina; vd, vas deferens; vgl, vaginal gland. Scale bars: 1 mm.

Distribution

Thus far this species is only known from Senegal.

External morphology

The body is elongate and limaciform with a long and pointed posterior end of the foot (Figure 1A). The preserved animals are about 28–33 mm in length. The living animals may reach 52 mm in length. The body surface is smooth. The foot is linear. The morphology of the head is characteristic in that the anterior margin dips into a 'U' shape (Figure 1B). The rhinophores are perfoliate bearing approximately 35 lamellae and arise from a smooth tapering sheath. The oral tentacles are short and broad, dorso-ventrally flattened and horizontally grooved. There are five non-retractile tripinnate gill branches forming a semicircle around the conical elevated anal papilla. The two posteriormost branches of each side share a common base. The genital pore opens on the right side, closer to the gill than to the oral tentacles. Lateral slots of unknown function are present below the rhinophores. The ground colour is dark blue with several dorsal and lateral yellow bands running from the head to the end of the tail (Figure 1A,B). Between these bands appear short sky-blue bands or spots, which can be slightly elevated. The spots on the tail form sky-blue tubercles. The pinnae of the gill are dark blue while the inner rachis of each gill branch is mostly yellow and the outer rachises are blue. The rhinophores are dark blue with sky-blue rhinophoral sheaths. The oral tentacles, the anterior margin of the head, the anal papilla, the genital pore and the foot are also bordered in sky-blue. In the middle of the head, on both sides of the notum, behind the rhinophores there are two distinctive dark blue spots, arrow-tip shaped (Figure 1B). Close to them are lighter blue eye spots.

Anatomy

The anterior digestive tract begins with a short thin-walled muscular oral tube that continues into the buccal mass. The buccal mass is longer than the oral tube. The elongated pouches at the junction of the buccal mass and the oral tube that are present in some species of the related genus *Roboastra* (Pola et al., 2003, 2005c) are not present in this species. There is a pair of elongate, narrow salivary glands on the buccal mass, flanking the oesophagus. The chitinous labial cuticle is thick, smooth, devoid of any rodlets but with an irregular inner edge (Figure 2A). The radular formula is 16×4.1.1.1.4 in the two specimens dissected (paratypes) (Figure 2B). The rachidian teeth are quadrangular, without denticles and notched at the anterior edge. The inner lateral teeth are elongate with two well-developed cusps. The inner cusp is simple, with a large, elongate and sharp denticle (Figure 2B). The outer lateral teeth are roughly rectangular and decrease in size towards the outer margin. There is a blood gland situated on the intestinal loop. The renal syrinx is visible under the pericardium, close to the anal papilla.

The reproductive system is triaulic (Figure 3A). A long and slender hermaphroditic duct connects to an elongate, thick-walled S-shaped ampulla. The ampulla narrows into a postampullary duct that bifurcates into an elongate and convoluted vas deferens and the short oviduct. The short oviduct enters the massive female gland mass. The prostate gland is large, slightly morphologically differentiated from the rest of the vas deferens and confined to a wide, coiled section of the vas deferens, which has soft walls. The penis is armed with numerous hooked spines (Figure 2E,F). The vaginal duct is straight, elongate and connects to the round bursa copulatrix. The seminal receptacle is pyriform, smaller in size than the bursa copulatrix. A short duct connects the seminal receptacle to the vagina after

completing two loops, near the bursa. A slender uterine duct leaves the vagina and joins with the female gland. The vagina shares a common atrium with the vaginal gland, which is small and elongate. The mucus gland is well developed.

Remarks

Tambja haidari is the first species of the genus described from Senegal. Four other species are described from waters close to the Cape Verde Islands (*T. fantasmalis* Ortea & García-Gómez, 1986, *T. anayana* Ortea, 1989, and *T. simplex* Ortea & Moro, 1999), and the Canary Islands (*T. ceutae* García-Gómez & Ortea, 1988), but these species clearly differ from *T. haidari* in their coloration and internal features (Ortea & García-Gómez, 1986; García-Gómez & Ortea, 1988; Ortea, 1989; Ortea & Moro, 1998; Pola et al., in press). *Tambja ceutae* resembles *T. haidari* not only in the general pattern of lines but also in the morphology of the head, which is characteristic in both animals where the anterior margin dips into a 'U' shape. *Tambja ceutae* lacks the sky-blue bands or spots of *T. haidari* but both have pointed tubercles along the edge of the notum and along the tail (Figure 1C). The radular formula of both species is very similar. The inner cusps of the lateral teeth are large in both but in *T. ceutae* the inner cusp is shorter and there is a small denticle on the inner side (Figure 2C), which is absent in *T. haidari*.

A species from the eastern Pacific, which shares some features with *T. haidari*, is *T. eliora* (Marcus & Marcus, 1967). *Tambja eliora* also has the same head morphology. The colour pattern of *T. eliora* slightly resembles *T. haidari* and *T. ceutae*, but it lacks tubercles on the body (Figure 1D). The lateral teeth also have simple inner cusps (Figure 2D).

Tambja blacki sp. nov.
(Figures 1E,F, 3B & 4)

Type material

Holotype: adult specimen, 45 mm preserved, dissected (Heron Island, Great Barrier Reef, Australia, water depth: 13 m) [South Australian Museum (Adelaide, Australia), SAM D19352]. Collected by Nerida Wilson, October 2000.

Etymology

This species is dedicated to Jim Black, fanatical diver and underwater photographer supreme, who over the years has shared numerous new species with the authors.

Distribution

Thus far this species is only known from Heron Island, Great Barrier Reef, Australia and Papua New Guinea [Willan & Coleman, 1984; Coleman, 1989, 2001 (referred to as 'painted *Tambja*'); Marshall & Willan, 1999; present study].

External morphology

The body is elongate and limaciform with a long, pointed and linear posterior end of the foot. The living animal is 130 mm (50 mm preserved). The body surface is smooth with large disconnected blotches arranged on the notum and both sides of the body (Figure 1E–G): two large and elongate blotches are located on the head running from the inner side of the base of the rhinophores towards the rear. There are two smaller blotches at the base of the two lateral gill branches and two others behind the gill circle. Several smaller spots might also be scattered on the anterior of the body (Figure 1G). Laterally, elongate blotches start close to the oral tentacles followed on each side by a smaller blotch. An additional large blotch is located in the middle of the posterior notum. Above the band that runs along the edge of the foot, there is another band ending in a large triangular patch on the foot. The notal margin is elevated and joins behind the gill in a well-developed hump-like structure (Figure 1E–G). Another band continues from the anterior margin between the rhinophores to the base of the gill. The rhinophores are perfoliate, retractile in their conical sheaths, with about 40 lamellae. There are three large non-retractile, tripinnate gill branches forming a semicircle around the conical elevated anal papilla. The oral tentacles are large but dorso-ventrally flattened and without a groove. The genital aperture is on the right side, approximately midway between the rhinophores and the gill. The lateral slots located between the rhinophores and the oral tentacles that are present in other species of *Tambja* (Yonow, 1994; Pola et al., 2005a; present study) are not visible in this species. The ground colour is yellow-green or green with dark green or black blotches (Figure 1E,F). The bands are dark brown bordered with orange. The anterior of the rhinophores is yellow or orange but the posterior is black. The outer rachis of the gill is brown bordered with orange or yellow and the inner rachis and pinnae are green. There is a yellow or orange band surrounding the foot.

Anatomy

The anterior digestive tract begins with a short thick-walled muscular oral tube that continues into the buccal mass. The buccal mass is longer than the oral tube and very large in comparison to the reproductive system. The elongated pouches at the junction of the buccal mass and the oral tube that are present in some other species of *Roboastra* (Pola et al., 2003, 2005c) are not present in this species. There is a pair of elongate salivary glands on the buccal mass, flanking the oesophagus. The chitinous labial cuticle is thick, smooth and devoid of any rodlets. The radular formula is 14×4.1.1.1.4 (Figure 4A). The rachidian tooth is small, quadrangular, without denticles and smooth at the anterior edge. The inner lateral tooth is elongate and robust with two wide cusps. The inner cusp is bifid, with a smaller denticle on its inner edge (Figure 4B). The outer lateral teeth are roughly rectangular and decrease in size towards the outer margin. There is a blood gland situated on the intestinal loop. The renal syrinx is visible under the pericardium, close to the anal papilla.

The reproductive system is triaulic (Figure 3B). The genital mass is very small in comparison with the size of the animal. The preampullary duct is short and narrow. It expands into a small 'S'-shaped ampulla, which divides into the short oviduct and the vas deferens. The short oviduct enters the albumen portion of the female gland mass. The short branch of the vas deferens widens into a very well differentiated, wide prostatic portion, which has a dense network of interconnecting tubules over its surface.

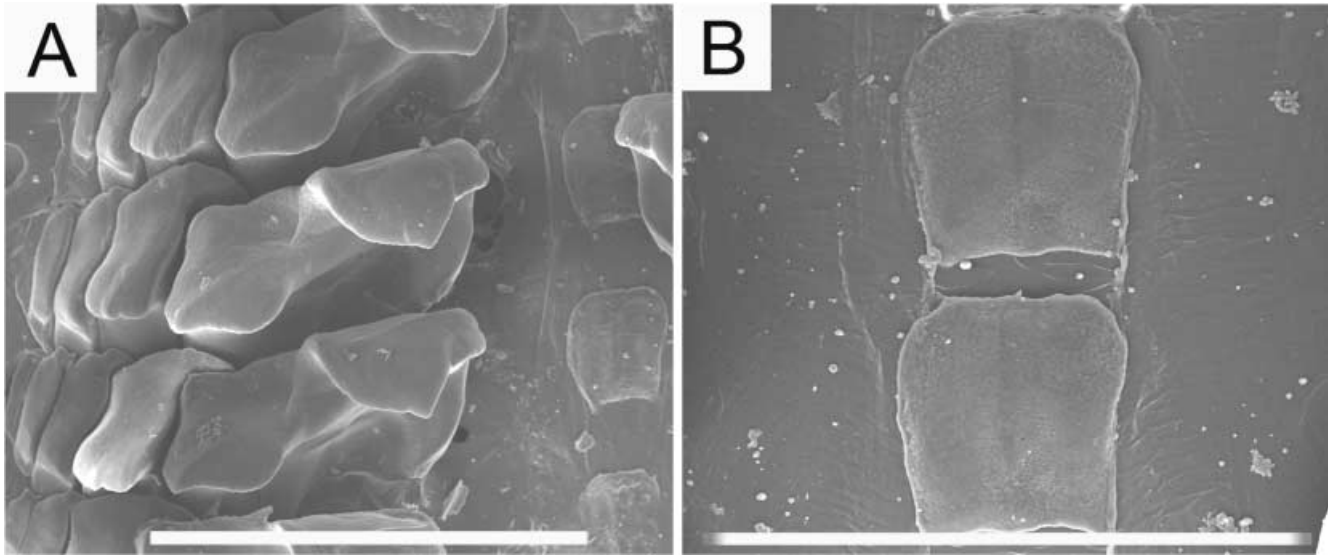

Figure 4. Scanning electron micrographs of *Tambja blacki* sp. nov. (holotype). (A) Left half of radula; (B) rachidian teeth; Scale bars A, 1 mm; B, 500 μm.

The vas deferens again narrows into an elongate, thin section, which descends through the centre of the following wide, highly coiled portion of the vas deferens. This coiled section continues into a wider, straight final portion in which penial spines were not observed. The vaginal duct is wide, long and slightly convoluted and connects to a large, round bursa copulatrix. The seminal receptacle is pyriform, much smaller in length than the bursa copulatrix. The seminal receptacle joins the proximal part of the vagina via a thin, long and coiled duct. An elongate uterine duct joins the base of the seminal receptacle with the female gland. A vaginal gland was not observed. *In situ*, the bursa is entirely surrounded by the prostate. In Figure 3B the prostate has been teased apart and is shown positioned to the side.

Remarks

Tambja blacki is clearly distinguishable from the other species of *Tambja* due to its large size, the coloration and the prominent crest behind the gill. A recently described species of *Tambja* from Brazil, *T. stegosauriformis* Pola, Cervera & Gosliner, 2005 (Figure 1H), also has the notal margin elevated and prominent crests behind the gill but the external morphology, the coloration and the geographical distribution are very different. *Tambja stegosauriformis* has yellowish-orange ground colour with blue tubercles while *T. blacki* is yellow-green or green with black blotches and has only one crest behind the gill. Both species lack lateral slots, which are usually present in most other species of the genus.

Regarding the reproductive system, a vaginal gland is absent and the prostate is spread over the bursa copulatrix. Only three described species of *Tambja* (*Tambja limaciformis*, *T. amakusana* and *T. abdere*) share these features, which are more characteristic of species of *Nembrotha*. An elongate, wide vagina is also present in *T. limaciformis* and *T. amakusana*, while a very long and coiled vagina is typical of *T. abdere*. Another important feature of *T. blacki* is the absence of penial spines in the mature specimen dissected for the present study. However, the absence of penial spines should be confirmed with examination of additional specimens.

This species, found in coral substrates, is moderately common between 12 to 24 m and feeds on the bryozoan *Amastina rudi* (Willan & Coleman, 1984; Coleman, 1989; Marshall & Willan, 1999). It swims readily by strong side-to-side flexions when irritated (Willan & Coleman, 1984; Marshall & Willan, 1999). Although this large polycerid has not been formally described until the present study, photographs of it have been included in no less than seven books (George & George, 1979; Coleman, 1981, 1989, 2001; Endean, 1982; Willan & Coleman, 1984; Marshall & Willan, 1999).

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